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FOREST INVENTORY STATISTICS
SITKA WORKING CIRCLE
NORTH TONGASS NATIONAL FOREST

Forest Survey Report No. 2

by
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(In-Service Use Only)

Forest Service
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Alaska Forest Research Center
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FOREWORD

This is the second in a series of reports on the forest area and timber volume of southeast Alaska. It is a product of the Forest Survey of southeast Alaska carried on by the Alaska Forest Research Center in cooperation with the Timber Management Division of Region 10 of the U. S. Forest Service.

The resource facts contained herein provide reliable data on a timber management unit basis for the Region's long-range plans and formulation of policies for timber production and for their guidance of forest industry development. These facts are also additive to the nation-wide survey being conducted by the Forest Service's Division of Economics Research.

Funds for the conduct of the survey were supplied by both Region 10 and the Forest Survey. The aerial photos used were loaned by the Region. Field work was accomplished during the field season of 1956.

From initial planning to final compilation, these people worked on the inventory:

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Acknowledgement is also made of cooperation from personnel of the Regional Office and the Forest Supervisor's staff of the North Tongass National Forest.

HIGHLIGHTS

Area

Forest area

More than two-thirds--71 percent--of the 2,433,300 acres of land within the exterior boundaries of the Sitka Working Circle is forested. Only 31 percent of the 1,740,200 forested acres, however, qualifies as productive, or commercial, forest land. Of the 540,700 acres of productive forest land about 31 percent--165,700 acres--is presently inaccessible due to current logging practices and economic climate in southeast Alaska. (Restocking areas and poletimber stands surrounded by accessible sawtimber stands are considered as accessible.)

Ownership

Ninety-nine percent of the commercial forest land area is adminstered by the Forest Service. At the time that the Sitka Working Circle was inventoried there were no areas of commercial forest land reserved from timber cutting. All of the 165,700 acres of inaccessible commercial forest land is in National Forest ownership.

Stand-size classes

Ninety-eight percent of the 537,900 acres of National Forest commercial forest land area is occupied by sawtimber stands. Of the 528,300 acres of sawtimber stands only one percent is classified as young-growth sawtimber stands.

Although there are 523,150 acres of commercial old-growth sawtimber stands on National Forest land only 69 percent is presently accessible. In addition to the 363,400 acres of accessible old-growth sawtimber stands there are 8,800 acres of young-growth stands within the accessible zone. This amounts to only 2.4 percent of the total accessible commercial forest area.

Forest types

About two-thirds of the National Forest commercial forest land area is occupied by the hemlock type. The hemlock-Sitka spruce ranks next with 21 percent followed by Sitka spruce with 9 percent and Alaska-cedar with 4 percent. On the accessible portion of the commercial forest area cedar comprises 5 percent of the area whereas it represents only about 2 percent of the inaccessible commercial forest area.

Timber Volume

Seventy-one percent of the more than 17.7 billion net board feet in the Sitka Working Circle is estimated to be presently accessible. Scattered throughout the accessible zone, however, are small timbered areas of questionable economic value at the present time. These are areas bearing primarily Alaska-cedar; areas of mature sawtimber which net less than 16,000 board feet per acre and young-growth stands bearing some sawtimber trees.

Slightly more than 65 percent of the total net board foot volume is in hemlock trees, with about 30 percent in Sitka spruce. About 4½ percent of the total volume is Alaska-cedar. Minor species, such as lodgepole pine, red alder and cottonwood, together make up less than one percent of the total.

Old-growth sawtimber stands, both accessible and inaccessible, contain about 99 percent of the board foot volume and in addition contain about 155 million board feet in salvable dead, standing sawtimber trees.

About 37 percent of the board foot volume or 6½ billion feet is found in trees in the 21-inch to 30-inch diameter class group. In descending order about 27 percent is found in trees 11 to 20-inches d.b.h., 22 percent in trees 31 to 40-inches d.b.h. and the remaining 14 percent in the 41-inch and larger diameter class group.

Old-growth accessible and inaccessible sawtimber stands are quite similar in that the average volume per acre for the former is about 34,000 b.f. and for the latter about 32,000 b.f. Of marked interest is the fact that 71 percent of the net board foot volume of cedar occurs in the accessible zone.

Defect in old-growth sawtimber trees is excessive. About 50 percent of the gross board foot volume of live merchantable sawtimber trees of Alaska-cedar is in cull material. Hemlock and Sitka spruce are 22 and 11 percent respectively. About 8 percent of the live hemlock sawtimber-size trees are cull trees yet they contain 13 percent of the gross board foot volume of the Working Circle. Of the total gross board foot volume in live sawtimber-size trees, about 17 percent of the spruce and 36 percent of the hemlock is lost due to rot and breakage.

Estimates of mortality and net volume of hemlock and Sitka spruce by log grades were not made due to the light sampling system. Estimates will be made, however, on a Regional basis. At that level this information will be more reliable.

Summary table of highlights, commercial forest land, Sitka Working Circle, 1956

	Commercial Forest Land			
	Accessible		Inaccessible	
	Area	Net volume	Area	Net volume
	Acres		Acres	
Total growing stock	375,000	2,598,496 MCF	165,000	1,105,967 MCF
Total sawtimber volume 1/	"	2,362,491 MCF	"	1,004,459 MCF
National Forest				
Old-growth sawtimber	363,400	12,379,878 MBF	159,800	5,104,521 MBF
Young-growth sawtimber	3,650	169,426 MBF	1,450	67,770 MBF

	Percent of Total Bd. Ft. Volume by Species	
	Accessible	Inaccessible
Hemlock	47.54	17.76
Sitka spruce	19.92	10.12
Alaska-cedar	3.17	1.30
Other	0.19	2/

1/ Includes only volume of sawlog portion of the tree.

2/ Negligible.

Table 1.--Land area by major classes of land and block, combined ownerships, Sitka Working Circle, 1956

Block	Land Class 1/				Total
	Forest Land			Non-forest land 2/	
	Accessible commercial	Inaccessible commercial	Non-commercial		
	Acres	Acres	Acres	Acres	Acres
1. Port Frederick	68,700	24,900	136,900	52,900	283,400
2. Freshwater	32,400	9,700	62,200	24,900	129,200
3. Elfin	7,600	2,800	34,800	29,000	74,200
4. Tenakee	57,100	22,400	163,100	56,300	298,900
5. Pelican	21,100	12,800	180,500	99,000	313,400
6. Hoonah	54,900	23,300	128,200	30,800	237,200
7. Peril Straits	65,900	34,300	120,200	46,900	267,300
8. Kelp Bay	23,500	13,400	78,200	110,300	225,400
9. Sitka	25,500	13,700	93,300	51,100	183,600
10. Crawfish	12,900	7,500	135,800	111,800	268,000
11. Alexander	5,400	900	66,300	80,100	152,700
Total	375,000	165,700	1,199,500	693,100	2,433,300
Percent of Total	15.41	6.81	49.30	28.48	100.00

1/ There are no areas of reserved commercial forest land in the Sitka Working Circle.

2/ Includes 4,406 acres of lakes from 10 to 40 acres in size that would be defined by the Bureau of Census as land but is classified as water by Survey standards of classification. Does not include tidewater.

Table 2.--Area of commercial forest land by ownership class and block, Sitka Working Circle, 1956 1/

Block	Ownership Class			Total
	National Forest	BLM	Private 2/	
	Acres	Acres	Acres	Acres
1. Port Frederick	93,500	--	100	93,600
2. Freshwater	42,000	--	100	42,100
3. Elfin	10,400	--	--	10,400
4. Tenakee	79,500	--	3/	79,500
5. Pelican	33,600	--	300	33,900
6. Hoonah	78,200	--	--	78,200
7. Peril Straits	100,100	--	100	100,200
8. Kelp Bay	36,900	--	--	36,900
9. Sitka	37,000	2,100	100	39,200
10. Crawfish	20,400	--	--	20,400
11. Alexander	6,300	--	--	6,300
Total	537,900	2,100	700	540,700

1/ Combined accessibility classes. All private and BLM lands; however, are accessible.

2/ Includes homesteads, patented mining claims and one church reserve. Housesites, fish cannery sites, trade and manufacturing sites, townsites and other similar areas bearing trees are not considered as commercial forest land.

3/ Less than 50 acres.

Table 3.--Net volume of live sawtimber on commercial forest land by ownership class and block, Sitka Working Circle, 1956

Block	Ownership Class			
	National Forest	BLM	Private	Total
	Thousand BF Scribner	Thousand BF Scribner	Thousand BF Scribner	Thousand BF Scribner
1. Port Frederick	3,127,149	--	3,407	3,130,556
2. Freshwater	1,367,245	--	3,407	1,370,652
3. Elfin	345,726	--	--	345,726
4. Tenakee	2,615,174	--	--	2,615,174
5. Pelican	1,070,282	--	10,220	1,080,502
6. Hoonah	2,626,508	--	--	2,626,508
7. Peril Straits	3,311,405	--	3,407	3,314,812
8. Kelp Bay	1,135,039	--	--	1,135,039
9. Sitka	1,233,037	71,541	3,407	1,307,985
10. Crawfish	680,187	--	--	680,187
11. Alexander	221,843	--	--	221,843
Total	17,733,595	71,541	23,848	17,828,984

Table 4.--Area of National Forest commercial forest land by block, Sitka Working Circle, 1956

Block	Commercial Forest Land		Total
	Accessible	Inaccessible	
	Acres	Acres	Acres
1. Port Frederick	68,600	24,900	93,500
2. Freshwater	32,300	9,700	42,000
3. Elfin	7,600	2,800	10,400
4. Tenakee	57,100	22,400	79,500
5. Pelican	20,800	12,800	33,600
6. Hoonah	54,900	23,300	78,200
7. Peril Straits	65,800	34,300	100,100
8. Kelp Bay	23,500	13,400	36,900
9. Sitka	23,300	13,700	37,000
10. Crawfish	12,900	7,500	20,400
11. Alexander	5,400	900	6,300
Total	372,200	165,700	537,900
Percent of Total	69.20	30.80	100.00

Table 5.--Net volume of live sawtimber on National Forest commercial forest land by block, Sitka Working Circle, 1956

Block	Commercial Forest Land		Total
	Accessible	Inaccessible	
	Thousand BF Scribner	Thousand BF Scribner	Thousand BF Scribner
1. Port Frederick	2,355,369	771,780	3,127,149
2. Freshwater	1,078,928	288,317	1,367,245
3. Elfin	256,865	88,861	345,726
4. Tenakee	1,898,250	716,924	2,615,174
5. Pelican	661,642	408,640	1,070,282
6. Hoonah	1,861,738	764,770	2,626,508
7. Peril Straits	2,216,302	1,095,103	3,311,405
8. Kelp Bay	801,188	333,851	1,135,039
9. Sitka	796,043	436,994	1,233,037
10. Crawfish	438,476	241,711	680,187
11. Alexander	193,490	28,353	221,843
Total	12,558,291	5,175,304	17,733,595
Percent of total	70.82	29.18	100.00

Table 6.--Area of National Forest commercial forest land by stand-size class and block, Sitka Working Circle, 1956

Block	Stand-size class and symbol					Total
	Old growth saw-timber (4)	Young growth saw-timber (3)	Pole-timber (2)	Seedlings & saplings (1)	Non-stocked (5)	
	Acres	Acres	Acres	Acres	Acres	Acres
Accessible						
1. Port Frederick	67,150	1,450	--	--	--	68,600
2. Freshwater	31,600	--	700	--	--	32,300
3. Elfin	7,600	--	--	--	--	7,600
4. Tenakee	55,600	--	750	750	--	57,100
5. Pelican	19,300	--	750	--	750	20,800
6. Hoonah	52,700	1,450	--	--	750	54,900
7. Peril Straits	65,100	--	--	700	--	65,800
8. Kelp Ba	23,500	--	--	--	--	23,500
9. Sitka	23,300	--	--	--	--	23,300
10. Crawfisn	12,900	--	--	--	--	12,900
11. Alexander	4,650	750	--	--	--	5,400
Total	363,400	3,650	2,200	1,450	1,500	372,200
Percent of Total	97.64	0.98	0.59	0.39	0.40	100.00
Inaccessible						
1. Port Frederick	24,150	--	--	--	750	24,900
2. Freshwater	8,950	--	750	--	--	9,700
3. Elfin	2,800	--	--	--	--	2,800
4. Tenakee	22,400	--	--	--	--	22,400
5. Pelican	12,800	--	--	--	--	12,800
6. Hoonah	21,850	1,450	--	--	--	23,300
7. Peril Straits	34,300	--	--	--	--	34,300
8. Kelp Bay	10,450	--	--	2,950	--	13,400
9. Sitka	13,700	--	--	--	--	13,700
10. Crawfish	7,500	--	--	--	--	7,500
11. Alexander	900	--	--	--	--	900
Total	159,800	1,450	750	2,950	750	165,700
Percent of Total	96.44	0.88	0.45	1.78	0.45	100.00

Note
Dashed entries do not necessarily indicate that areas of these stand-sizes do not exist in the particular blocks. Small areas may exist. However, none were encountered during the sampling procedure.

Table 7.--Net volume of live sawtimber on National Forest commercial forest land by stand-size class and block, Sitka Working Circle, 1956

Block	Stand-size class and symbol 1/				
	Old growth saw-timber (4)	Young growth saw-timber (3)	Pole-timber (2)	Seedlings & saplings (1)	Total
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner
	Accessible				
1. Port Frederick	2,287,599	67,770	--	--	2,355,369
2. Freshwater	1,075,938	--	2,990	--	1,078,928
3. Elfin	256,865	--	--	--	256,865
4. Tenakee	1,895,249	--	2,995	6	1,898,250
5. Pelican	658,652	--	2,990	--	661,642
6. Hoonah	1,793,968	67,770	--	--	1,861,738
7. Peril Straits	2,216,296	--	--	6	2,216,302
8. Kelp Bay	801,188	--	--	--	801,188
9. Sitka	796,043	--	--	--	796,043
10. Crawfish	438,476	--	--	--	438,476
11. Alexander	159,604	33,886	--	--	193,490
Total	12,379,878	169,426	8,975	12	12,558,291
Percent of Total	98.58	1.35	0.07	2/	100.00
	Inaccessible				
1. Port Frederick	771,780	--	--	--	771,780
2. Freshwater	285,327	--	2,990	--	288,317
3. Elfin	88,861	--	--	--	88,861
4. Tenakee	716,924	--	--	--	716,924
5. Pelican	408,640	--	--	--	408,640
6. Hoonah	697,000	67,770	--	--	764,770
7. Peril Straits	1,095,103	--	--	--	1,095,103
8. Kelp Bay	333,828	--	--	23	333,851
9. Sitka	436,994	--	--	--	436,994
10. Crawfish	241,711	--	--	--	241,711
11. Alexander	28,353	--	--	--	28,353
Total	5,104,521	67,770	2,990	23	5,175,304
Percent of Total	98.63	1.31	0.06	2/	100.00

1/ No board foot volume in stand-size class 5 (nonstocked).

2/ Less than one-hundredth of one percent.

Table 8.--Area of National Forest commercial forest land by forest type and block, Sitka Working Circle, 1956

Block	Forest Type and Symbol 1/				Total
	Hemlock (H)	Hemlock Sitka spruce (H-S)	Sitka spruce (S)	Cedar (C)	
	Acres	Acres	Acres	Acres	Acres
Accessible					
1. Port Frederick	46,500	14,800	3,800	3,500	68,600
2. Freshwater	20,500	7,800	2,000	2,000	32,300
3. Elfin	4,700	2,200	400	300	7,600
4. Tenakee	34,950	12,550	6,000	3,600	57,100
5. Pelican	13,000	4,800	2,200	800	20,800
6. Hoonah	34,400	12,400	4,900	3,200	54,900
7. Peril Straits	45,400	13,650	3,850	2,900	65,800
8. Kelp Bay	15,600	4,900	1,600	1,400	23,500
9. Sitka	14,800	5,800	1,750	950	23,300
10. Crawfish	9,350	2,500	600	450	12,900
11. Alexander	3,350	800	1,050	200	5,400
Total	242,550	82,200	28,150	19,300	372,200
Percent of Total	65.17	22.08	7.56	5.19	100.00
Inaccessible					
1. Port Frederick	16,800	4,350	3,100	650	24,900
2. Freshwater	6,300	1,700	1,400	300	9,700
3. Elfin	1,800	550	400	50	2,800
4. Tenakee	15,400	4,000	2,600	400	22,400
5. Pelican	9,700	2,250	800	50	12,800
6. Hoonah	15,700	4,800	2,400	400	23,300
7. Peril Straits	25,200	6,100	2,500	500	34,300
8. Kelp Bay	7,200	2,000	4,000	200	13,400
9. Sitka	9,700	2,500	1,300	200	13,700
10. Crawfish	5,650	1,250	550	50	7,500
11. Alexander	500	200	150	50	900
Total	113,950	29,700	19,200	2,850	165,700
Percent of Total	68.77	17.92	11.59	1.72	100.00

1/ Small areas of Hardwood type may occur; however, none were encountered during the sampling procedure.

Table 9.--Net board foot volume of live sawtimber on National Forest commercial forest land by species and block, Sitka Working Circle, 1956

Block	Species 1/				Total
	Hemlock	Sitka spruce	Alaska-cedar	Other 2/	
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner
Accessible					
1. Port Frederick	1,585,629	659,702	103,862	6,176	2,355,369
2. Freshwater	722,536	304,638	48,848	2,906	1,078,928
3. Elfin	171,971	72,538	11,662	694	256,865
4. Tenakee	1,271,076	536,012	86,044	5,118	1,898,250
5. Pelican	443,162	186,797	29,904	1,779	661,642
6. Hoonah	1,255,156	520,292	81,446	4,844	1,861,738
7. Peril Straits	1,483,815	625,882	100,619	5,986	2,216,302
8. Kelp Bay	536,395	226,256	36,374	2,163	801,188
9. Sitka	532,951	224,803	36,139	2,150	796,043
10. Crawfish	293,560	123,826	19,906	1,184	438,476
11. Alexander	133,903	51,910	7,246	431	193,490
Total	8,430,154	3,532,656	562,050	33,431	12,558,291
Inaccessible					
1. Port Frederick	467,776	269,274	34,730	--	771,780
2. Freshwater	175,133	100,344	12,840	--	288,317
3. Elfin	53,858	31,004	3,999	--	88,861
4. Tenakee	434,527	250,135	32,262	--	716,924
5. Pelican	247,677	142,574	18,389	--	408,640
6. Hoonah	476,546	256,859	31,365	--	764,770
7. Peril Straits	663,742	382,081	49,280	--	1,095,103
8. Kelp Bay	202,352	116,473	15,022	4	333,851
9. Sitka	264,862	152,467	19,665	--	436,994
10. Crawfish	146,501	84,333	10,877	--	241,711
11. Alexander	17,185	9,892	1,276	--	28,353
Total	3,150,159	1,795,436	229,705	4	5,175,304

1/ Block volumes derived on assumption that species distribution is similar for all blocks within an accessibility class.

2/ Includes lodgepole pine, red alder and cottonwood.

Table 10a.--Net volume of all timber on National Forest accessible commercial forest land by class of material and species group, Sitka Working Circle, 1956

Class of Material	Total	Softwood	Hardwood
	Thousand cubic feet	Thousand cubic feet	Thousand cubic feet
Growing stock			
Sawtimber trees			
Sawlog portion	2,349,851	2,343,548	6,303
Upper stem portion	100,605	99,579	1,026
Total	2,450,456	2,443,127	7,329
Poletimber trees	134,135	132,541	1,594
Total growing stock	2,584,591	2,575,668	8,923
Other material			
Sound cull trees	5,841	5,841	--
Rotten cull trees	37,044	36,970	74
Hardwood limbs	71	--	71
Salvable dead	20,397	20,397	--
Total "other material"	63,353	63,208	145
Total, all timber	2,647,944	2,638,876	9,068

Table 10b.--Net volume of all timber on National Forest inaccessible commercial forest land by class of material and species group, Sitka Working Circle, 1956

Class of material	Total	Softwood	Hardwood
	Thousand cubic feet	Thousand cubic feet	Thousand cubic feet
Growing stock			
Sawtimber trees			
Sawlog portion	1,004,459	1,004,449	10
Upper stem portion	42,682	42,680	2
Total	1,047,141	1,047,129	12
Poletimber trees	58,826	58,700	126
Total growing stock	1,105,967	1,105,829	138
Other material			
Sound cull trees	1,443	1,443	--
Rotten cull trees	17,634	17,634	--
Hardwood limbs	38	--	38
Salvable dead	6,555	6,555	--
Total "other material"	25,670	25,632	38
Total, all timber	1,131,637	1,131,461	176

Table 11.--Net board foot volume of live sawtimber on National Forest commercial forest land by species and diameter class groups, Sitka Working Circle, 1956

Species	Diameter Class Group				Total volume by Species	Percent by species
	11.0" to 20.9" d.b.h.	21.0" to 30.9" d.b.h.	31.0" to 40.9" d.b.h.	41.0" d.b.h. and larger		
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	
Sitka spruce	752,088	1,396,298	1,541,463	1,638,243	5,328,092	30.04
Hemlock 1/	3,532,995	4,834,864	2,341,305	871,149	11,580,313	65.31
Alaska-cedar	465,677	256,869	52,879	16,330	791,755	4.46
Lodgepole pine	2,983	1,969			4,952	0.03
Red alder	28,477				28,477	0.16
Cottonwood	6				6	2/
Total volume by d.b.h. classes	4,782,226	6,490,000	3,935,647	2,525,722	17,733,595	100.00
Percent by d.b.h. classes	26.97	36.60	22.19	14.24	100.00	

1/ Western hemlock and mountain hemlock combined.

2/ Less than one-hundredth of one percent.

Table 12.--Average net volume per acre in live merchantable trees on commercial forest land by land type and stand-size class, Sitka Working Circle, 1956

Land type	Stand-size class				
	Old growth saw-timber (4)	Young growth saw-timber (3)	Pole-timber (2)	Seedlings & saplings (1)	Nonstocked (5)
1. Accessible					
B.F. Scribner	34,067	46,165	4,074	8	0
Cubic foot	6,989	9,552	1,815	57	0
2. Inaccessible					
B.F. Scribner	31,930	46,165	4,074	8	0
Cubic foot	6,821	9,552	1,815	57	0

Note--Average volume per acre for stand-sizes 1, 2, 3 and 5 obtained from a very small sample. Necessary to combine accessible and inaccessible field plots.

Cubic foot volume includes volume in both live poletimber and sawtimber trees to a 4-inch top d.i.b.

Table 13.--Defect volume in old-growth sawtimber stands by species, Sitka Working Circle, 1956

Species	Gross volume of all live trees, cull and merchantable	Total volume in live cull trees	Volume of defect in merchantable trees	Breakage volume in merchantable trees	Net merchantable volume
	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner	MBF Scribner
Sitka spruce	6,425,536	150,948	747,965	113,679	5,355,022
Hemlock	17,982,757	2,348,367	3,732,554	197,479	11,644,193
Alaska-cedar	2,292,616	620,095	844,263	14,662	796,080
Total	26,700,909	3,119,410	5,324,782	325,820	17,828,984

Table 14.--Proportion of defect and breakage in old-growth sawtimber stands by species, Sitka Working Circle, 1956

Class of material	Sitka spruce	Hemlock	Alaska-cedar
	Percent	Percent	Percent
Merchantable trees			
1. Proportion of total gross b.f. volume of live merchantable trees in rotten cull material	11.0	22.0	50.0
2. Breakage in live merchantable sawtimber trees	4.5	4.5	4.5
All live trees			
3. Proportion of all live sawtimber trees that are cull trees	2.8	7.7	16.1
4. Proportion of total gross b.f. volume in cull trees	2.0	13.0	27.0
5. Proportion of total gross b.f. volume of working circle lost due to rot and breakage	17.0	36.0	65.0

Estimates of defect derived from Kimmey, James W., Cull Factors for Sitka spruce, Western hemlock, and Western redcedar, Alaska Forest Research Center Sta. Paper No. 6, 1956.

APPENDIX

EXPLANATION OF TERMS

Land-Use Classes

Forest land.--Includes (a) lands that are at least 10 percent stocked by trees of any size and capable of producing timber or other wood products, or of exerting influence on the climate or on the water regime; (b) land from which the trees described in (a) have been removed to less than 10 percent stocking, and which has not been developed for other use. (Forested tracts and islands of less than 10 acres and isolated strips of timber less than 120 feet wide are excluded.)

1. Commercial forest land - Forest land producing or capable of producing usable crops of industrial wood.

   a. Commercial accessible - Commercial forest land presently accessible and economically available now and which has not been withdrawn from use.

   b. Commercial inaccessible - Commercial forest land presently inaccessible and economically unavailable now and not withdrawn for specified purposes. Changing economic climate and improving logging methods probably will make portions available for development in the future.

   Commercial reserved - Commercial forest land withdrawn from timber utilization through statute, ordinance or administrative order. (Classed as noncommercial productive reserved by the Forest Survey).

2. Noncommercial forest land - Forest land incapable of producing usable industrial wood because of adverse site conditions and not withdrawn for specified purposes.

3. Noncommercial reserved forest land - Noncommercial forest land withdrawn for specified purposes through statute, ordinance or administrative order.

Nonforest land.--Includes land which has never supported forest growth; land from which the forest has been removed to less than 10 percent stocking and has been developed for other use, such as agricultural, residential, or industrial; all land in thickly populated urban and suburban areas; house sites; trade and manufacturing sites; lighthouse reserves; and water classified by the Bureau of the Census as land, i.e., less than 40 acres in size. Glaciers, ice fields, marsh land above mean high tide, permanent brush fields, muskegs less than 10 percent stocked to trees of any size and barren mountain tops are examples of lands which have never supported forest growth.

Forest types

Commercial forest types

Forest types are classified on the basis of the predominant species or species group that accounts for the major portion of the stand in terms of net board foot volume for sawtimber, cubic volume for poles and number of trees for seedling-sapling stands.

Sitka spruce.--Forests in which Sitka spruce is predominant.

Hemlock-Sitka spruce.--Forests in which 50 percent or more of the stand is hemlock but in which Sitka spruce makes up 30 to 49 percent of the stand.

Hemlock.--Forests predominately hemlock except when Sitka spruce comprises 30 to 49 percent of the stand.

Cedar.--Forests predominately western redcedar or Alaska-cedar, singly or in combination.

Hardwood.--Forests predominately cottonwood or red alder, singly or in combination.

Noncommercial forest types

Scrub.--Forests characterized by open stands of stunted, limby, defective trees of no present or prospective value. All tree species may be present. Mature stands will net less than 8000 board feet per acre (Scribner rule).

1. Stands occupy swanp-like soils and contain a dense understory of blueberry and other shrubs.
2. Stands at the upper limits of tree growth.
3. Stands within the altitudinal range of merchantable timber but occupying sites too rocky and too sterile to produce merchantable timber.

Class of Timber

Sawtimber trees.--Live trees of commercial species at least 11.0-inches d.b.h. with at least 25 percent of their gross board foot volume free from rot or other defect and that contain at least one merchantable sawlog. A merchantable sawlog is not less than 16 feet long, at least 6-inches d.i.b. at the small end for softwoods and 8-inches d.i.b. for hardwoods, and which after deductions for defect contains a net scale of 33-1/3 percent. However, for any log to be merchantable it must contain at least 20 board feet (Scribner rule). Merchantable height was based on the number of 16 foot logs in softwoods to a top d.i.b. of 40 percent of d.b.h., except in the case of small trees where the minimum top is 6 inches. For hardwoods it was the number of 8 foot logs to a minimum top of 8-inches d.i.b. for small trees and 40 percent of d.b.h. for large trees.

Poletimber trees.--Live trees 5.0-inches to, but not including, 11.0-inches d.b.h. These trees are of sufficiently good form and condition to indicate that they will grow into merchantable sawtimber trees.

Seedling and sapling trees.--Live trees of commercial species less than 5.0-inches d.b.h. and of sufficiently good form and vigor to indicate that they will grow into merchantable sawtimber trees.

Cull trees.--Live trees 5.0-inches d.b.h. and over that do not qualify as sawtimber or poletimber trees due to poor form, limbiness, rot or other defect.

1. Rotten cull trees contain excessive decay.
2. Sound cull trees have excessive crook, sweep or large limbs.

Salvable dead trees.--Standing dead sawtimber-size trees containing at least one merchantable sawlog and containing at least 50 percent of the tree gross board foot volume in sound material.

Hardwood limbs.--Limbs of hardwood sawtimber trees and sawtimber-size cull hardwood trees to a minimum diameter of 4.0-inches inside bark.

Stand-size Classes

Sawtimber stands.--Forest stands in which the minimum volume for coniferous types is 8,000 net board feet (Scribner) per acre in merchantable trees 11.0-inches and larger. For hardwood sawtimber stands the minimum volume is 4,000 net board feet (Scribner) per acre.

1. Old-growth.--Sawtimber stands in which the majority of volume is in sawtimber trees more than 150 years of age.

2. Young-growth.--Sawtimber stands in which the majority of volume is in sawtimber trees less than 150 years of age.

Poletimber.--Stands failing to meet the sawtimber stand specification, but at least 10 percent stocked with poletimber and larger trees, and with at least half the minimum stocking in poletimber trees.

Seedling and sapling.--Stands not qualifying as either sawtimber or poletimber, but having at least 10 percent stocking of trees of commercial species and with at least half the minimum stocking in seedlings-and-saplings.

Nonstocked and other areas.--Commercial forest land not qualifying for any other class.

Volume Estimates

Sawtimber volume.--Net volume in board feet, Scribner rule, of that portion of live sawtimber trees between stump and the upper limit of merchantability for sawlogs. Volume deductions were made for defects and breakage. Cull factors for hemlock, spruce and cedar were obtained from Station Paper No. 6, Alaska Forest Research Center. Cull for other species and breakage were cruiser's estimates.

Cubic-foot volume:

Growing stock.--Net volume in cubic feet of live merchantable sawtimber trees and live poletimber trees of commercial species from stump to a minimum 4.0-inch top (of central stem) inside bark.

All timber volume.--Net volume in cubic feet of live poletimber trees, live and salvable dead sawtimber trees and cull trees of commercial species from stump to a minimum 4.0-inch top inside bark. Includes also the volume of all hardwood limbs to a minimum diameter of 4.0-inches inside bark.

SPECIES TALLIED 1/

The following commercial tree species were tallied in the Sitka Timber Management Unit. Other tree species of minor importance may occur in this area, but unless they were tallied on the field plots they were not included in the following list.

Softwoods:	Sitka spruce	- Picea sitchensis
	Hemlock	
	Western hemlock	- Tsuga heterophylla
	Mountain hemlock	- Tsuga mertensiana
	Alaska-cedar	- Chamaecyparis nootkatensis
	Lodgepole pine	- Pinus contorta
Hardwoods:	Red alder	- Alnus rubra

FOREST SURVEY PROCEDURES

Area Estimate

The point sampling technique on 100 percent aerial photo coverage was used to obtain the various area statistics. A series of five sample plots were systematically located on each effective 1:40,000 vertical

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1/ Little, Elbert L., Jr. Check list of native and naturalized trees of the United States (including Alaska). U. S. Dept. Agr., Agr. Handbook 41, 472 pp. 1953.

aerial photo of the unit. The photo plots that were established were sufficient to meet the requirements of an allowable sampling error of 3 percent of commercial forest land in terms of one standard error.

Each photo plot was then stereoscopically examined and classified as to forest or nonforest. The classification for each photo plot was determined on the basis of the 10-acre area including and immediately surrounding the plot. Plots classified as forest were then transferred to 18° oblique 1:20,000 aerial photos as this photo scale is better suited for more intensive forest examination. Next, the forest plots were classified as to commercial or noncommercial. Finally, the commercial forest plots were stratified by accessibility, forest type, stand-size and density classes. This procedure is known as stratification. The classified plots of each block were then summarized by stratum.

A sample of the plots were randomly selected and field checked. Field classifications were checked against the original photo classification for any differences in interpretation. The field check data was used to adjust the photo classification data for all of the plots in the survey unit if any differences occurred.

The detailed area data from the point samples was then expanded to the unit level. First, the known gross area of the unit was divided by the total number of photo plots to determine the number of acres represented by each. Then, the area for each stratum was a result of the product of the number of plots and the area represented by a plot.

To determine the accuracy of the office photo classification a sample of photo plots was checked in the field. A predetermined number of photos were selected at random and all of the plots on each photo, called a cluster, were examined. The number of photo clusters examined was determined by the formula: 1/

$$\left(\frac{S_{Paf}}{P_{af}}\right)^2 = \left[\frac{\sum_{i=1}^{k} N_{if}\,(1-P_{if})}{\left(\sum_{i=1}^{k} n_{if}\right)^2} + \left[C^2 n'_{if} + C^2 n'_{if} - 2r_{(n'_{if})(n_{if})} C_{n'_{if}}\, C_{n_{if}}\right]\left[\frac{k-m}{k}\right]\frac{1}{m}\right]$$

1/ Formula recommended by Roy Chapman, statistician, Washington office.

in which:

m = number of clusters to be checked

$\frac{S_{Paf}}{P_{af}}$ = relative error of proportion in commercial forest

k = total number of photos to give complete coverage

ni = number of points examined in the i-th cluster

n_{if} = number of points classed as commercial forest land

$C_{n_{if}}$ = coefficient of variation of the n_{if}

n'_{if} = number of points examined in the field

P_{if} = proportion in commercial forest land

$C'_{n_{if}}$ = coefficient of variation of the n'_{if}

$r_{(n'_{if})(n_{if})}$ = correlation coefficient between n_{if} and n'_{if}

Areas determined by photo-interpretation are corrected by applying a factor or ratio as determined from the comparison of photo and field classification of the random sample selected for field checking. A total of 328 photo classifications were checked in the field.

Volume Estimate

A portion of the photo plots classified as commercial forest land were randomly selected for field examination. At the field locations, survey crews collected such data as species, diameters, merchatable heights, defect, mortality, stand-size class, forest type, etc., on three plots each one-fifth acre in size at two chain intervals.

The collected data was recorded in numerical code and sent to the Data Processing Unit at the California Forest and Range Experiment Sta. Data was compiled by IBM machines following the detailed procedures contained in "Plan for Compilation of the Alaska Forest Survey by the IBM Method". Briefly the procedure is as follows: All of the data recorded for each tree is punched on individual tree cards by location. Then the proper cull factor is applied to each tree. The trees are then sorted and data compiled by various classes such as by species, by 10-inch d.b.h. classes, by stand-size classes, by accessibility classes, etc. The tree volumes are then expanded to a per acre basis and per acre breakage factors by species applied to obtain net volume per acre. Net volumes per acre are then applied to area by classes to obtain class totals by timber management blocks.

Sufficient plots were selected at random to attain a specified level of statistical accuracy. The survey was designed for maximum efficiency in estimating total volume to meet the requirements of the Timber Management Division of Region 10 and the national survey. The allowable error for Region 10 requirement is 5 percent of total board foot volume per unit and for the national survey 10 percent per one billion cubic feet of growing stock for the Coastal Alaska sub-region.

The number of commercial forest land ground plots selected at random was determined by using the formula: 1/

$$E^2 = \frac{C^2}{n} + \frac{q}{mp}$$

where: E = allowable error
C = coefficient of variation
n = number of ground plots
m = number of photo plots
p = proportion of photo plots on commercial forest land
q = proportion of photo plots on nonforest and noncommercial forest land

A total of 129 photo plots were examined on the ground.

Sample locations examined by timber management block, Sitka Working Circle, 1956

Block	Photo plots	Ground locations	Check plots
1. Port Frederick	386	24	49
2. Freshwater	176	12	20
3. Elfin	101	2	12
4. Tenakee	407	15	46
5. Pelican	427	6	36
6. Hoonah	323	23	35
7. Peril Straits	364	22	44
8. Kelp Bay	307	9	27
9. Sitka	250	9	23
10. Crawfish	365	4	23
11. Alexander	208	3	13
Total	3,314	129	328

1/ Formula recommended by Floyd Johnson, Statistician, Pacific Northwest Forest and Range Experiment Station.

ACCURACY OF THE ESTIMATES

Errors which affect the accuracy of the area and volume estimates in this report may arise from two sources:

1. Non-sampling errors.--These are human mistakes in judgment, measurement, recording, or arithmetic. There is no practical method of finding out just how often such errors occur. These errors are kept to a minimum, however, by a diligent effort to maintain a high degree of accuracy in the collection and compilation of data and closely checking all phases of the work.

2. Sampling errors.--These errors arise from using sampling procedures rather than making a 100 percent inventory. These errors can be measured. They are the only measurable errors involved in computing the reliability of the estimates.

Accuracy of the Forest-area Estimates

Forest-land class	All ownership Area	Sampling error
	Acres	Percent
Commercial accessible	375,000	± 4.1
Commercial inaccessible	165,700	± 6.3
Total commercial	540,700	± 3.3
Noncommercial	1,199,500	± 1.8

The probabilities are two out of three that the actual commercial forest land area is within ± 3.3 percent of the estimated area.

The sampling error for total commercial forest land was calculated from the formula:

$$SE = \frac{\sqrt{\frac{PQ}{n}}}{P}$$

P = proportion of commercial forest land
Q = 1 - P
n = total number of photo plots

Sampling errors of National Forest commercial forest land area by timber management blocks were calculated by the formula:

$$SE_a = \frac{SE_A}{\sqrt{\frac{a}{A}}}$$

SE_a = sampling error of any block
SE_A = sampling error of CFL of the unit
A = total area of CFL in unit
a = area of CFL in any TM block

Block	Area Sampling Error, National Forest Commercial Forest Land		
	Accessible	Inaccessible	Total CFL
	Percent	Percent	Percent
1. Port Frederick	± 9.2	± 15.2	± 7.8
2. Freshwater	13.4	24.0	11.7
3. Elfin	27.8	44.2	24.0
4. Tenakee	10.1	16.1	8.5
5. Pelican	16.6	21.1	13.0
6. Hoonah	10.2	15.9	8.6
7. Peril Straits	9.4	13.0	7.6
8. Kelp Bay	15.5	21.1	12.5
9. Sitka	15.9	20.3	12.5
10. Crawfish	21.1	8.5	17.0
11. Alexander	34.1	76.0	31.1

With each subdivision of the unit total, the percentage error increases so that small acreages may have large errors and therefore indicate only relative magnitudes.

Accuracy of the Timber Volume Estimates

Commercial forest	Sawtimber	
	Volume	Sampling error
	M Bd. Ft. Scribner	Percent
Accessible	12,558,291	6.5
Inaccessible	5,175,304	10.2
Total	17,333,595	5.5

The probabilities are two out of three that the actual sawtimber board-foot volume is within ± 5.5 percent of the estimated total volume.

The sampling error for total volume was calculated from the formula:

$$E^2 = \frac{C^2}{n} \div \frac{q}{mp}$$

E = sampling error
C = coefficient of variation
n = total No. of ground plots in any class
m = total No. of photo plots
p = proportion of photo plots on commercial forest land
q = 1 - p

Sampling errors of volume on National Forest commercial forest land by timber management blocks were calculated from the formula:

$$SE_V = \frac{SE_V}{\sqrt{\frac{v}{V}}}$$

SE_V = sampling error of total volume
V = total volume of working circle
v = volume of a block

Block	Volume Sampling Error - Sitka Working Circle - National Forest Commercial Forest Land		
	Accessible	Inaccessible	Total CFL
	Percent	Percent	Percent
1. Port Frederick	± 15.1	± 26.2	± 13.1
2. Freshwater	22.3	43.5	19.8
3. Elfin	46.5	77.8	39.9
4. Tenakee	16.8	27.5	14.3
5. Pelican	28.6	36.3	22.5
6. Hoonah	17.0	26.5	14.3
7. Peril Straits	15.6	22.1	12.7
8. Kelp Bay	25.9	39.9	21.7
9. Sitka	25.9	34.8	20.8
10. Crawfish	34.8	46.5	28.2
11. Alexander	52.4	123.0	50.2

With each subdivision of the Working Circle, the percentage error increases so that small volumes may have large sampling errors and therefore indicate only relative magnitudes.

COEFFICIENT OF VARIATION

The coefficient of variation as determined from the total field plots examined on commercial forest land was 50 percent. This was calculated on the basis of the net board-foot volume (Scribner) of live merchantable sawtimber trees.

TABLE OF SCRIBNER TO INTERNATIONAL ¼-INCH RATIOS

Species	10" - DBH Group	Ratio 1/
Western hemlock,	11.0" to 20.9"	1.16
Mountain hemlock and	21.0" to 30.9"	1.09
Sitka spruce	31.0" to 40.9"	1.05
	41.0" and larger	1.03
Alaska-cedar	all diameters	1.14
Western red cedar	" "	1.16
Lodgepole pine	" "	1.16
Hardwoods	" "	1.15

1/ Ratio for converting Scribner b.f. volume to International ¼-inch b.f. volume at the per acre level.

AVERAGE FORM CLASS, 16-FOOT LOG

Species	Form class
Western hemlock	82
Mountain hemlock	82
Sitka spruce	82
Alaska-cedar	79
Lodgepole pine	75
Hardwoods	77

CAUSES AND TYPES OF CULL 1/

Cull in living trees is largely due to decayed wood, but some may be due to sound defect from such causes as shake, crook, and sweep. Shake is the only sound defect that contributes appreciably to cull in the stands of Southeast Alaska. Loss of volume from burning, as found in large fire scars in other regions, is inconsequential in this rain forest. Sound cull from shake caused a loss of board-foot volume but was not considered a loss in cubic volume.

1/ Kimmey, James W.
1956. Cull factors for Sitka spruce, western hemlock and western red cedar in southeast Alaska. Station Paper No. 6, Alaska Forest Research Center.

Most board-foot cull and all cubic-foot cull was due to decayed wood. Decayed wood is of two types: "brown rot" and "white rot". In brown rot the casual fungi attack primarily the cellulose fibers; in white rot, the lignin content of the wood. Likewise, two general stages of decay were recognized in this study analysis. They are the early, or incipient, stage of decay and the late, or typical, stage.

In the incipient stage the affected wood is usually discolored and firm, but often somewhat softened and weakened. Low grades of lumber may be manufactured from such wood. This wood may also be used in pulp making, though some weakening of fiber results when incipient decay of the brown rot type is used. Wood in the typical stage of decay will not make lumber, even of low grade, and the typical stage of brown rot makes wood unsuited for pulp of any kind. Part of the wood containing typical decay of the white rot type, however, may be used in pulp making but with considerable loss of yield.

In the southeast Alaska study both brown and white rot, in both the incipient and typical stages, were considered to be cull; therefore, the cull factors discount all decayed wood. In certain uses for timber it may be desirable to know the type of rot or stage of decay likely to be found in the cull of a tree species. Table 1 shows for the various tree species the percentage of each type of rot in each stage of decay based on the cubic-foot volumes of cull found in the study trees.

Table 1.--Percent of white rot and brown rot in each stage of decay by tree species.

Tree species	White rot		Brown rot		All rot	
	Incip.	Typ.	Incip.	Typ.	Incip.	Typ.
Sitka spruce	27	73	39	61	37	63
Western hemlock	36	64	36	64	36	64
Western redcedar	77	23	57	43	77	23

If timber is to be used primarily for pulp, it will undoubtedly be desirable to know what percent of the total cull is caused by white rot and what part of the white rot is in the incipient stage of decay. Since all cubic-foot cull was caused by decay, the significance of each type of rot and each stage of decay in the total cull of a tree species can be read from table 2.

Table 2.--Percent of total cubic cull volume caused by each type of rot and stage of decay in each tree species.

Tree species	White rot			Brown rot		
	Incip.	Typ.	Total	Incip.	Typ.	Total
Sitka spruce	4	12	16	33	51	84
Western hemlock	22	40	62	14	24	38
Western redcedar	76	22	98	1	1	2

In western redcedar 98 percent of the total cubic cull was caused by white rot, of which 77 percent occurred in the incipient stage. In other words, more than three-fourths of the total cull in redcedar consisted of white rot in the incipient stage of decay--a type of cull material that may have limited use in both lumber and pulp manufacture.